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ABSTRACT

This training profile is intended for use by program developers and trainers in the development of training courses and programs for sheet metal workers. It contains 17 modules: safety for sheet metal worker; tools and machinery; materials and gauges; drafting and shop drawing; pattern development; methods of joining sheet metal; shearing and cutting sheet metal; sheet metal forming and assembly procedures; welding; blueprint reading; heating, ventilating, and air conditioning; architectral roofing and siding; acoustic treatment; air balancing; industrial environment systems; trade calculations; and related science. Each module consists of these components: tasks as identified by an occupational analysis; terminal performance objectives, which identify the required behavior, the conditions, and the minimum acceptable performance standards; and enabling objectives, which identify the knowledge and skills required to achieve the terminal performance objective. (YLB)

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Ministry of Skills Development
Ontario

The Honourable Gregory Sorbara,
Minister

Sheet Metal Worker

A Training Profile

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SHEET METAL WORKER

A Training Profile

Ministry of Skills Development

The Honourable Gregory Sorbara, Minister

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PREFACE

This training profile is for use by program developers and trainers in the development of training courses and programs. It is specific to the occupation of Sheet Metal Worker.

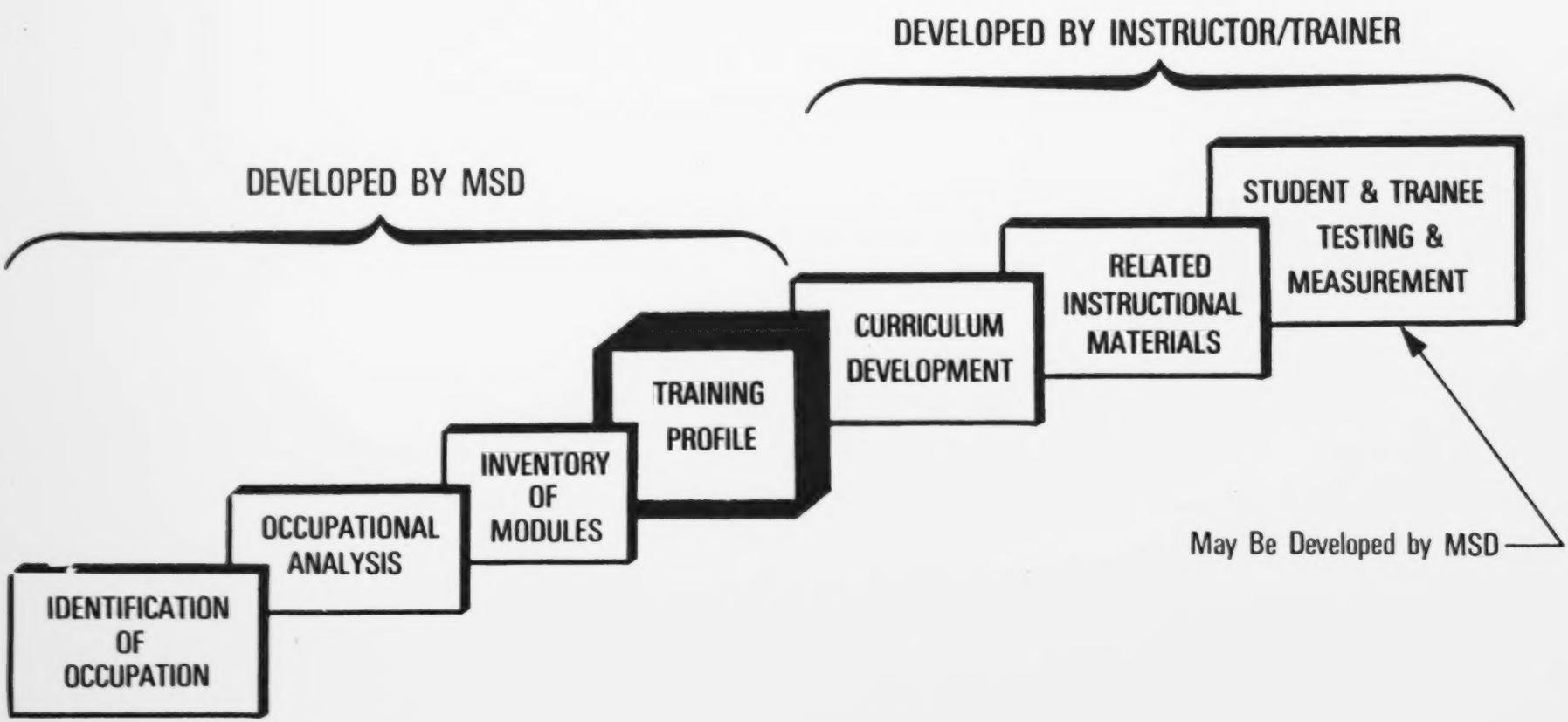
It provides the minimum provincial performance standards for training to the competencies identified for this occupation by qualified representatives of business, industry, or professions.

This training profile does not represent a program nor is it a curriculum document. It is the basis upon which institutional and/or on-job curriculum, courses, and programs can be developed by colleges, other training institutions, and employers. General educational courses appropriate to program needs are not included in this training profile but are expected to be incorporated in the training program by the curriculum developers.

It is based on the identification of tasks through an occupational analysis from which modules of training are developed. Such modules contain Tasks, Terminal Performance Objectives (TPOs), and Enabling Objectives (EOs). Criteria and conditions established within each TPO define the minimum acceptable standards for training.

This training profile as a component of the program development process is illustrated on page 7.

THE TRAINING PROFILE IN THE PROGRAM DEVELOPMENT PROCESS



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The Ministry of Skills Development gratefully acknowledges the contributions made to the development of this training profile by the representatives of business and industry and the colleges of applied arts and technology who served on the Training Profile Committee, namely:

Mr. L. Cianfarani	Toronto Sheet Metal and Air Handling Group	Toronto
Mr. A. Clayton	George Brown College of Applied Arts and Technology	Toronto
Mr. T. Dyer	Fanshawe College of Applied Arts and Technology	London
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Mr. S. Quin	Sheet Metal Local #537	Hamilton
Mr. N. Rosenthal	Royce Metal Products Ltd.	Toronto
Mr. A. White	Sheet Metal Local #30	Toronto

Messieurs John Lissack and Frank Graham, Program Co-ordinators, Ministry of Skills Development, represented the ministry as members of the committee.

INTRODUCTION

This training profile contains modules which consist of:

- Tasks as identified by the occupational analysis;
- Terminal Performance Objectives (TPOs) which identify the required behaviour, the conditions, and the minimum acceptable performance standards; and
- Enabling Objectives (EOs) which identify the knowledge and skills required to successfully achieve the TPO.

This training profile provides the minimum performance standards for training to the competencies identified for the occupation of Sheet Metal Worker by qualified representatives of the Sheet Metal industry. Such standards are stated in performance-objective terms.

The method of delivery of training based on this occupational training profile will be described in a program description.

DESCRIPTION OF OCCUPATION

A Sheet Metal Worker:

(i) fabricates, manufactures, assembles, erects, installs, repairs, alters, reconditions, adjusts, services, or tests all ferrous and non-ferrous sheet metal work of No. 10 U.S. Standard gauge or equivalent and thinner and other materials used in lieu thereof, and;

(ii) reads, understands, and interprets architectural and engineering blueprints, and shop and field sketches derived from them used in fabrication, assembly and erection, and applied pattern development as required.

LISTING OF MODULES

MODULE NUMBER	MODULE TITLE	PAGE
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Training Module

Module Title

SAFETY FOR SHEET METAL WORKERS

No.

U992

Module Objective

PRACTISE TRADE SAFETY.

Date JUNE 1985

No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
992.01	work within legislation, plant regulations, and other accepted standards	State the obligations and rights of the employer and the worker as defined in: . the Ontario Occupational Health and Safety Act . the Canada Labour Code . The Ontario Workers' Compensation Act . local plant safety rules and regulations Describe the purpose of the Construction Safety Association of Ontario.	Work within legislation and regulations as they pertain to the workplace in accordance with the Occupational Health and Safety Act.
992.02	describe safety hazards	Identify the correct behaviour and the equipment required to avoid hazards to safety and health caused by: . horseplay and practical jokes . loose clothing, necktie, and street shoes . rings, watches, pendants, and other ornamental objects . long hair . poor housekeeping . lifting and carrying of heavy objects . blocked aisles . improper handling and storage of material . improper start-up of machinery . revolving machine components and/or workpieces . improper use of chemicals . contact with toxic chemicals, fluids, and materials . combustible fluids, gases, lubricants, and materials . air quality . water quality . open flames (continued)	Describe potential safety hazards in accordance with the requirements of the Occupational Health and Safety Act.

No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
992.02	(continued)	. improper handling and storage of gas cylinders . absence of fire extinguishers . improper handling and operation of electrical equipment . poor connections . improper grounding . improper handling and operation of pneumatic equipment . improper use of compressed air	
992.03	practise safety in the workplace	Determine and apply effectively: . safety clearances . confined entry procedures Identify and use properly: . ladders . scaffolds . material-handling and rigging equipment, i.e., hoists, slings, etc. . hoisting hand-signals . walkie-talkie or similar devices . personal safety equipment Secure materials: . on-the-job site . in transportation Protect, cover, or barricade openings State the correct procedures to follow in reporting an accident Ascertain availability of telephones and numbers to call in case of accident	Practise safety in the workplace in accordance with the Occupational Health and Safety Act.

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No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
992.04	select and use personal protective equipment	Identify the proper personal protective equipment or clothing for various parts of the body: . head protection - hard hats . eye protection - safety glasses - goggles - full-face shields . hearing protection - ear plugs - ear muffs . breathing protection - dust masks - life-support systems . gloves and aprons . safety belts and harness . safety shoes and boots Select and properly wear, adjust, and maintain protective equipment or clothing Identify the specified equipment required: . types . size and fit . material . protective features and limitations . application	Select and use the correct type of safety equipment or clothing required to give optimum protection in accordance with the Occupational Health and Safety Act.

No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
992.05	practise fire prevention	Identify the three main elements of combustion Identify fires according to the following types: . Class A . Class B . Class C . Class D Operate the proper fire extinguisher in a correct manner	Practise fire prevention by carrying out emergency fire procedures such as: . inspecting workplace for hazards and taking appropriate action; . locating the fire; . activating alarms; . selecting fire extinguishers and following fire fighting procedures.
992.06	rig material	Demonstrate safety practices when handling materials Move or hoist equipment using: . slings and ropes . cables . even distribution of weight Demonstrate methods of checking equipment for wear and tear Demonstrate typical knots used in rigging	Rig material to be handled using proper safety techniques to move or hoist material from one place to another in accordance with the Occupational Health and Safety Act.
992.07	use hand signals	Employ correct hand signals when instructing a crane operator	Use hand signals in connection with handling or lifting sheet metal materials and equipment in accordance with the Occupational Health and Safety Act.

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Ontario

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Training Module

Module Title

TOOLS AND MACHINERY (SHEET METAL WORKER)

No.

U993

Module Objective

IDENTIFY AND SELECT TOOLS AND MACHINES COMMONLY USED IN THE SHEET METAL INDUSTRY.

Date JUNE 1985

No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
993.01	select hand tools	Identify types of hand tools in terms of . size and shape . application . strength . capacity . operating range	Select trade hand tools such as the following: . aircraft snips: - left, - right, - straight; . regular snips; . combination snips; . duckbill snips; . bulldog snips double cutting; . compound lever bench shear: - iron, - power; . hammers: - ballpeen, - rivetting, - setting, - planshing; - smoothing; . mallets: - wood, - leather composition, - plastic, - pear shape; . scratch awl - scriber; . centre punch: - hollow, - prick; . solid punch; . hand iron and power punches; . hand groover: - rivet sets, - chisels; . bench squares: - combination, - protractors; . straightedge; . wing dividers; (continued)

No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
993.01	(continued)		. spring dividers; . trammel points: - scan compass, - quick sets; . screw drivers: - slot, - Allen, - Phillips, - Robertson, - ratchet; . pliers: - adjustable, - round nose, - snip nose; . folding tongs; . seamers; . wrenches: - open end, - box, - ratchet, - adjustable; . measuring tools: - scales, - tapes, - rulers; . roll forming machines: - hand, - powered; . drill bits; . stocks and dies; . threaders; . band saws.

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No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
993.02	select and operate machines	Identify the types of machines indicated in terms of: . strength . size . capacity . operating range	Select and operate the following trade machines: . bar folder - Smiths bender; . turning machines: - easy edger, - burr, - wiring, - crimping, - bender, - swedging, - set down, - ogee bead; . hand brakes: - slitting cornice, - box and pan brake-drop leaf; . power brake and power gauges; . shears: - gap pedestal shear, - power shear, - ring and circle shear, - rotary shear, - floor and bench lever shear; . power turning combination machine (four heads); . cleat forming machine; . notching machine; . angle iron notching and bending machine; . iron master; . tinners stakes; . breadhorn - double seaming; . bevel edge - square and coppersmith; . blowhorn, creasing stake, candle mold; . needle case, hatchet, bottle, tea kettle; . solid mandrel; (continued)

No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
993.02	(continued) 31		. hollow mandrel; . anvil; . bench bars; . rod bender. 32

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Training Module

Module Title

MATERIALS AND GAUGES FOR SHEET METAL WORKERS

No.

U994

Module Objective

SELECT MATERIALS AND GAUGES.

Date JUNE 1985

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No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
994.01	select materials	Determine the following: . identifiable material characteristics . identifying codes . colour . weight . grain texture . finishes Determine physical properties: . tensile strength . ductility . malleability . hardness	Select materials of the following type: . hot roll steel, sheet, and coil; . cold roll steel; . galvanized steel; . tinplate; . terneplate; . aluminized steel; . enamel - painted steel; . PVC coated steel; . nickel alloys; . aluminum; . copper; . brass; . zinc; . lead.
994.02	select plastic materials	Describe: . major types of plastic compounds, their characteristics, and uses . PVC characteristics and limitations . PVC forming, fabrication, and joining methods . fibreglass and polypropylene . reinforced fibreglass cloth, resins, and catalysts	Select plastic materials with respect to specific trade applications, costs, and durability.
994.03	select gauges	State the following gauge standards: . standard U.S. wire gauge . Brown and Sharpe metal gauge . copper (ounces per square foot) . lead (pounds per square foot)	Select the various gauges of material in Imperial or SI gauges (including U.S. standard) for: . non-ferrous metals; . ferrous metals; . thermoforming and thermosetting plastics.

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Training Module

Module Title

DRAFTING AND SHOP DRAWING FOR SHEET METAL WORKER

No.

U995

Module Objective

APPLY BASIC DRAFTING TECHNIQUES.

Date JUNE 1985

No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
995.01	identify and apply basic drafting techniques	Select and use: . drafting paper and pencils . T-square and set squares . erasers and eraser shields . lettering guides . Imperial and metric scales . measuring tools . compasses and french curves . templates Identify and apply: . invisible edges . dimensioning . sections and material symbols . basic isometric drawings (introduction to) . geometric construction techniques	Identify and apply basic drafting techniques to produce the following to required trade standards: . three-view drawing; . freehand sketch; . isometric drawing.
995.02	reproduce a drawing	Identify and apply drawing reproduction processes by: . scaling . computer . print machine	Reproduce a drawing to required specifications.
995.03	interpret blueprints	Interpret mechanical and electrical elevation plans Make a graphical drawing of the floor plans Lay out trunk and branch ducts Size and estimate materials required	Interpret equipment and material installation details from blueprints provided.

No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
995.04	develop detailed shop sketches	Extract detail from blueprints provided and develop shop sketches Collect data from a job site or installation	Develop detailed shop sketches from blueprints and/or measurements and data taken from the field.

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Training Module

Module Title

PATTERN DEVELOPMENT FOR SHEET METAL WORKER

No.

U996

Module Objective

DEVELOP A PATTERN USING VARIOUS METHODS.

Date JUNE 1985

No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
996.01	develop patterns for various profiles	Read blueprints to determine size and profile State methods and principles of obtaining stretch-out and joint lines for patterns Make allowances for seams, folds, and joints Determine mitre lines and types of notches	Develop patterns for various profiles such as: . rectangular; . elliptical; . round; in accordance with job specifications.
996.02	prepare material for fabrication or assembly	Develop forming diagrams Develop lines and reference points indicating: . bends . bend angle . pole locations . slot locations	Prepare materials on paper or metal by reference points required for fabrication operations as established for the trade.
996.03	use detailed blueprints to develop patterns by the parallel line method	Prepare material for fabrication and/or assembly	Use parallel line method to develop patterns for: . straight rectangular ducts; . mitre ducts; . compound angle; . round pipe with mitred ends; . intersecting shapes; . round elbows.
996.04	produce sheet metal patterns employing the triangulation method	Describe methods and principles required to produce patterns for transforming shapes	Produce sheet metal patterns using the triangulation method for specified shapes and sizes of fittings.

No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
996.05	use radial line method	Describe methods and principles required for developing conical forms Describe methods of determining joint lines including: . two-elevation methods . common-centre sphere method . cutting-plane method	Use radial line methods to develop patterns of conical shapes such as: . right cones; . oblique cones; . pyramids.
996.06	demonstrate the techniques of custom layout	Describe methods and principles of combining: . radial line . parallel line . triangulation . combination of all three	Demonstrate the techniques of custom layout and produce items which required combined methods.

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Training Module

Module Title

METHODS OF JOINING SHEET METAL

No.

U997

Module Objective

PRODUCE SHEET METAL JOINTS AND SEAMS.

Date JUNE 1985

No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
997.01	produce hand-made longitudinal and transverse joints	Select appropriate seam or joint for various gauges, materials, and applications as follows: . gauges up to and including 10 SWG . ferrous and non-ferrous materials . thermosetting and thermoforming plastics Calculate size and allowance for bending operation Complete final assembly of hand-made seams	Produce hand-made longitudinal and transverse joints to trade specifications for residential, commercial, and industrial applications.
997.02	produce machine-made longitudinal and transverse joints	Select appropriate equipment to produce seams in various gauges, materials, and applications as follows: . gauges up to and including 10 SWG . ferrous and non-ferrous materials . thermosetting and thermoforming plastics Calculate size and allowance for machine forming Complete final assembly for machine-made seams	Produce machine-made longitudinal and transverse joints to required specifications for residential, commercial, and industrial applications.
997.03	produce hard and soft soldering seams	With approved methods, correctly heat, shape, and tin soldering iron Observe safety procedures when handling heating devices and fluxes Identify and select various types of soldering alloys for suitable applications (continued)	With soldering iron or torch, safely produce hard and soft soldered seams of uniform strength and appearance.

No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
997.03	(continued)	Identify and select suitable corrosive or non-corrosive flux for given applications State or demonstrate the necessity of cleanliness during soldering procedures Select and apply correct flame or temperature setting for soldering seam Clean or wash soldered seam by: . washing . sanding . buffing using hand or powered equipment	
997.04	produce seams by mechanical methods	Select mechanical fastener in accordance with specific application Calculate pitch and hole size for the following types of mechanical seams: . rivet . bolt . pop rivet . metal screw . spot weld	Produce seams by mechanical methods such as: . rivet; . bolt; . pop rivet; . metal screw; . spot weld; in accordance with application specifications.
997.05	produce connections using dovetail and fishlock seams	Select type of seam and calculate allowance in accordance with gauge and shape	Produce connections using dovetail and fishlock seams in accordance with S.M.A.C.N.A. standards and practices.

No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
997.06	install mechanical fasteners	Identify and state the application of various types of fasteners used in the trade including: . power-actuated . self-drilling . self-gripping and expanding devices Determine suitability of fastener for various installations List the various fastening methods using hand or power operated tools	Install mechanical fasteners safely and securely using approved methods and including the following types: . power-actuated; . self-drilling; . self-gripping and expanding devices; in accordance with specifications.

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The Honourable Gregory Sorbara, Minister

Training Module

Module Title

SHEARING AND CUTTING METAL

No.

U998

Module Objective

CUT METAL USING TRADE TOOLS.

Date JUNE 1985

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No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
998.01	cut a straight or curved line with hand snips and shears	Correctly measure and mark allowances Select suitable hand-operated snips for ferrous and non-ferrous sheet metal up to 10 SWG	Cut a straight or curved line to produce openings and notches in sheet metal using hand snips and shears.
998.02	cut a straight or curved line with portable reciprocating power machines	Correctly measure and mark edges to be cut with portable cutting machines	Cut a straight or curved line to produce openings and notches in sheet metal with portable reciprocating power machines.
998.03	cut a straight or curved line with a bench or floor mounted rotary hand or power operated machines	Determine as applicable for specified hand or power cutting operation: . required sequence for each cut . supporting and holding requirements . necessary devices to be employed	Cut a straight or curved line using a bench or floor mounted hand or power operated machine to a given line.
998.04	cut a straight line with a foot or power operating squaring shear	Determine as applicable for the specified hand or power cutting operation: . required sequence for each cut . support and holding requirements and necessary devices to be employed	Cut a straight line with a foot or power operated squaring shear to a given line.
998.05	cut a straight or curved line with a cold chisel	Select chisel appropriate to: . type of metal . tolerance allowance of cut	Cut a straight or curved line using a cold chisel to a given line.

No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
998.06	cut straight or curved line using plasma arc cutting methods	Describe machine set-up and cutting accessories Correctly determine pressure, speeds, and tip sizes for various cutting applications	Cut straight or curved lines using plasma arc cutting methods with ferrous and non-ferrous metal of up to and including 10 SWG.

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Ontario

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Training Module

Module Title

SHEET METAL FORMING AND ASSEMBLY PROCEDURES

No.

U999

Module Objective

FORM AND ASSEMBLE METALS.

Date JUNE 1985

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No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
999.01	form an edge or profile using a hand operated rotary bench machine	Identify: . old type T22 - T75 - T . current type number 42, 43 to specific material and gauge	Form an edge or profile using a hand operated rotary bench machine to produce a required shape to trade standards.
999.02	form an edge or profile using a power rotary machine	Identify the correct forming wheels to: . burr . flange . hem . turn . ream and set down . false wire . bead (single and double) . crimp . bead and crimp cylindrical and/or conical shapes	Form an edge or profile using a power operated rotary machine to produce a specified shape to trade standards.
999.03	form an edge with a bar folder	Identify: . single-hemmed edge . double-hemmed edge . drive cleat . flat S cleat . angle S cleat	Form an edge with a bar folder to specified angle radius of curvature and depth of edge (bend).
999.04	form a shape using various angular forming machines and hand tools	Determine: . allowance . tolerance to bend . cleats and specified transforming shapes of various sections	Form shape using various angular forming machines and hand tools to required specifications.

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No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
999.05	form a shape using a power brake	Determine the allowances and adjustments required for various metal thicknesses Determine: . tolerance to bend . seams - flat and standing . cleats - flat and standing . transforming shapes for specific sections, i.e., round to oblong Select appropriate dies and tools for specified gauge of material	Form a shape such as: . radius; . hemmed edges; . combination bend; using power brake and to required specifications.
999.06	form a shape using a bench bar, mandrel, and stake	Shape and seam square, round, cylindrical, and tapered forms	Form a shape to required job specifications without tools marks and by using a bench bar, mandrel, and stake.
999.07	form cylindrical and conical shapes with hand rollers	Form a workpiece round without flats Form a conical shape without flats	Form cylindrical and conical shapes to a specified diameter and shape using hand rollers.
999.08	form cylindrical and conical shapes with power rollers	Form a workpiece into a cylinder without flats Form a workpiece into a cone without flats	Form cylindrical and conical shapes to a specified diameter and shape using power rollers.

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No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
999.09	fabricate and assemble various transforming shapes	Select the correct layout method Select the correct machine Select hand tools Form pattern into a required shape Select appropriate method of seaming	Fabricate and assemble various transforming shapes to shop standards.

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Training Module

Module Title

WELDING (Sheet Metal Worker)

No.

U1000

Module Objective

USE ARC AND OXY-ACETYLENE EQUIPMENT TO WELD AND CUT.

Date JUNE 1985

No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
1000.01	demonstrate "safety first" as it relates to gas and electric welding	Identify common hazards inherent in welding processes Apply safety procedures: . personal safety precautions . protective clothing	Demonstrate "safety first" as applied to welding and in accordance with the Occupational Health and Safety Act.
1000.02	state the preliminary safety considerations and the basic techniques of oxy-acetylene welding and cutting	Interpret welding terminology State the physical characteristics of metal and alloys: . melting points . heat transfer . oxidation . carbonization . fusion . penetration . adhesion Apply the various oxy-acetylene welding processes Describe the limitations of each type of welding	State the preliminary safety procedures and techniques as applied to oxy-acetylene welding and cutting.
1000.03	operate oxy-acetylene equipment	State: . types of joints . types of flame and gas mixture - regulator pressures - adjustment . methods of preparing the material . basic weld joints . welding, cutting, and brazing techniques (continued)	Operate oxy-acetylene equipment including: . oxygen; . acetylene; . pressure gauges and regulators; using metals of up to and including 10 SWG.

No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
1000.03	(continued)	Light and adjust the torch: . working pressures . flame adjustment . importance of turning the acetylene "on" first and "off" first Use oxy-acetylene torches effectively and safely: . flame temperature and characteristics . types of torches . pressure and proportioning Use regulators effectively and safely: . principle of operation . operating pressures . regulator testing Select and use hoses and connections: . colour . left-hand threads . testing procedures . safety	
1000.04	produce clean, firm welds in the flat and horizontal position 68	Identify the types of flames: . reducing . neutral . oxidizing Select and set up the welding equipment: . cylinders . regulators . hoses . torches . tips Test for leaks (continued)	Produce clean, firm welds in the flat and horizontal position including: . lap weld; . corner; . fillet; . butt; . single vee. 69

No.	Task To be able to: .	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
1000.05	produce clean cuts	Select the cutting torch: . types and applications . types of cutting tips . cutting tip sizes . regulator pressures . starting cuts . hand cutting . safe practice	Produce clean cuts using cutting equipment to a tolerance of ± 1/8".
1000.06	use gas welding equipment	State the methods of welding and identify: . edge preparation . distortion . weld faults Perform necessary procedures to: . clean . set up joints . adjust flame temperatures . apply fluxes . use filler rods	Use gas welding equipment to perform basic welds and brazing in horizontal and vertical positions as required in the trade.
1000.07	demonstrate the technique of using electric arc welding equipment	List the specific safety precautions to be taken Arc weld various metals using prescribed procedures for all positions Identify and describe: . carbon arc gouging . plate and edge preparation . carbon arc gouging . characteristics of electrodes and application (continued)	Demonstrate the techniques of using electric arc welding equipment to perform: . gas metal arc welding (G.M.A.W.); . arc; . gas and arc welding (G. and A.W.); . gas tungsten arc welding (G.T.A.W.).

No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
1000.07	(continued)	Review basic processes and the necessary machine setup for: . G.M.A.W. . G. and A.W. . G.T.A.W. Select and use: . filler rods . gases . electrodes	
1000.08	arc weld	Describe: . polarity and current requirements . types of welding equipment . flat and horizontal fillet welding techniques . electrodes and filler rods . welding, cutting, and brazing techniques Operate wire-feed welding machines	Produce arc welds in accordance with trade requirements.
1000.09	perform the basic techniques of electric arc welding	Identify the types of arc welding equipment and their characteristics: . trade terminology . polarity and current requirements . advantages and limitations Select electrodes and filler rods	Perform basic techniques of electric arc welding, adjust the machine, and make an acceptable weld in accordance with trade requirements.

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No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
1000.10	perform the basic techniques of carbon arc welding	Identify the types of arc welding equipment and their characteristics: . trade terminology . polarity and current requirements . advantages and limitations . electrodes and filler rods . importance of correct length of electrode Select electrodes and filler rods	Perform the basic techniques of carbon arc welding to trade requirements.
1000.11	control weld distortion	Determine and apply distortion control measures for the following: . shrinkage . angular distortion . transverse shrinkage . longitudinal distortion . longitudinal shrinkage	Control weld distortion as per job specification and/or trade standards.

Ministry of Skills Development
Ontario

The Honourable Gregory Sorbara, Minister

Training Module

Module Title

BLUEPRINT READING (Sheet Metal Worker)

No.

U1001

Module Objective

INTERPRET MECHANICAL PLANS AND DRAWINGS.

Date JUNE 1985

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No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
1001.01	read and interpret mechanical plans of industrial complexes and shop ducting	Interpret job-related blueprints and drawings for installation purposes Interpret job specifications, including addenda Prepare floor plans: . construction details . layout of trunk and branch ducts . legends . uniduct design	Read and interpret mechanical plans of industrial complexes and shop ducting as specified.
1001.02	read and interpret blueprints and schematic drawings	Carry out drafting procedures and techniques: . use of lines . projections . views . sections . developments . dimensions . lettering . symbols . hidden details . geometrical drawings . freehand sketching . introduction to isometric drawing Prepare elementary working drawings: . dimensional sketches of ductwork layouts . duct work . jigs . fixtures . orthographic and isometric drawings . multiview drawings . piping and material symbols . applications (continued)	Read and interpret blueprints and schematic drawings as provided by architects and mechanical engineers.

No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
1001.02	(continued)	Interpret: . architectural structural drawings . equipment manufacturers' drawings . standard architectural symbols . materials specifications . threads and fasteners . frame . masonry . concrete construction plans . materials . construction members . dimensioning . sectioning . elevations . details . schedules . working drawing	
1001.03	identify from drawing sheet metal work to be done and the anticipated effect on other trades	Co-relate: . plan views . elevations . sections . detail sections . reflected ceiling plans	Identify from plan views elevations and job specifications of sheet metal work to be done in co-operation with other tradespersons.
1001.04	do preliminary estimating	Use blueprints in estimating: . material quantities . equipment . labour - installation and fabrication Provide a summary of costs	Do preliminary estimating from job specifications as required by the trade.

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Ministry of Skills Development
Ontario

The Honourable Gregory Sorbara, Minister

Training Module

Module Title

HEATING, VENTILATING, AND AIR CONDITIONING

No.

U1002

Module Objective

ASSEMBLE AND ERECT DUCTS.

Date JUNE 1985

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No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
1002.01	select and apply reinforcing methods and materials	Select and use: . band iron . angle iron . tee iron . channel iron Identify and apply reinforcement fastening methods	Select and apply appropriate reinforcing methods and materials as required by S.M.A.C.N.A.
1002.02	assemble and erect shop-fabricated plenums and ducts	Identify types of plenums and casings, and their construction Identify and apply methods of stiffening and reinforcing Select and form the correct joining for a given application Identify and apply fasteners Place turning vanes and turning vane blades in duct: . low pressure . medium pressure . high pressure Assemble and install plenums and ducts State the relationship of plenums and ducts to air-handling equipment: . provision of access doors and openings . gaskets and sealants	Assemble and erect shop-fabricated plenums and ducts in accordance with requirements of S.M.A.C.N.A.

No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
1002.03	use approved techniques to assemble computer and/or raised floors	Identify components: . stringers . legs . adjusting bolts . panel . flanging . expansion joints . sealants	Use approved techniques to assemble raised floors and balance air according to level of floor required as required by S.M.A.C.N.A.
1002.04	assemble and install rectangular ducts	Identify: . types, weights, and gauges of materials . types of cleats State: . methods of jointing, lapping, and fastening . types and uses of hanging devices - masonry anchors - bolts - screws - rivets - nails . methods of positioning and installing hangers . use of power-actuated stud guns . techniques of duct assembly . techniques of duct installation . importance of correct positioning and installation of fire dampers . use of sealants and taping Read blueprints	Assemble and install rectangular ducts with reference to S.M.A.C.N.A.

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No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
1002.05	assemble and erect shop-fabricated round ducts	Identify the types of special materials including plastics Identify and apply joining methods and devices Identify and install various types of hangers and supports Select and apply sealants and tapes Install collector systems, stacks, chimneys, and breechings	Assemble and erect shop-fabricated round ducts with reference to S.M.A.C.N.A. and building codes.
1002.06	install duct insulation	Identify types and uses of duct insulation and how it is applied: . acoustic lining . thermal resistance . condensation barrier State: . uses of sound baffles . types and uses of factory-built silencers . significance of decibel ratings	Install duct insulation in accordance with S.M.A.C.N.A.
1002.07	install roof ventilators	Describe the types and uses of roof vents: . stationary . cowls . gravity ventilators . louvred penthouse	Install roof ventilators in accordance with specifications and building codes.

No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
1002.08	install indicating devices and controls	Describe and demonstrate types of control and indicating devices State methods of installation State care and use of filter gauges and manometers	Install indicating devices and controls in accordance with building codes and specifications established by S.M.A.C.N.A.
1002.09	install louvres and shutters	Describe: . types and methods of installing fixed and adjustable louvres . types and methods of installing shutters . importance of installing suitable bird and fly screens	Install louvres and shutters in accordance with the building codes and specifications established by S.M.A.C.N.A.
1002.10	install grills and ceiling outlets	Describe the methods of installing different types of grills and ceiling outlets	Install grills and ceiling outlets in accordance with building codes and specifications established by S.M.A.C.N.A.
1002.11	install fans and blowers	Describe fans and blowers with respect to: . types, functions, and characteristics . methods of mounting and installing . methods of aligning components Read blueprints and manufacturers' drawings and specifications	Install fans and blowers in accordance with building codes and specifications established by S.M.A.C.N.A.

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No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
1002.12	install direct-fired heating and air-conditioning equipment	Describe: . types and characteristics of gravity units and forced air units . advantages and disadvantages of the various types . importance of heat measurement - quantity (BTU) - intensity (temperature) . importance of factors affecting human comfort . importance and methods of providing adequate ventilation for boiler and furnace rooms . importance of safety codes covering installation of heating units, ducts, and vents	Install direct-fired heating and air-conditioning equipment in accordance with specifications, building codes, S.M.A.C.N.A., and H.R.A.I.
1002.13	install air-handling components	Describe the types and uses of: . air washers . humidifiers . dehumidifiers . spray eliminators and dust collectors . filters - their types and characteristics - electronic precipitators - activated carbon - replaceable media - washability Describe the techniques of installing collectors Describe the types and methods of installing: . preheat coils . reheat coils . direct expansion coils for cooling and dehumidifying . electric duct heaters	Install air-handling components in accordance with specifications, building codes, S.M.A.C.N.A. and H.R.A.I.

No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
1002.14	use air-measuring instruments	Apply the principles of air-flow measurement and systems balancing Select and use air-measuring instruments to determine velocities in low, medium, and high-pressure ducts	Use air-measuring instruments to measure and balance air flow required by S.M.A.C.N.A.
1002.15	install components	Select equipment components for: . air washers . humidifiers . dehumidifiers . spray eliminators . dust collectors Select and install filters: . replaceable media . washable . electronic precipitators . activated carbon types Select and install preheat expansion coils for cooling and dehumidifying electric duct heaters	Install components as required in the following types of equipment: . air washers; . humidifiers; . dehumidifiers; . spray eliminators; . dust collectors. Installation is to be made in accordance with equipment manufacturer's specifications.
1002.16	fabricate and assemble the sheet metal components of an air-conditioning system	Select: . fittings . materials . gauges . components	Fabricate and assemble the sheet metal components of an air-conditioning system in accordance with the requirements of S.M.A.C.N.A.

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No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
1002.17	install alternative energy systems	Demonstrate a typical installation and the uses of: . solar energy . heat pumps . heat reclaiming	Install alternative energy systems and explain the practical uses of: . solar energy; . heat pumps; . heat reclaiming.
1002.18	install fans and blowers	Demonstrate fans and blowers with respect to: . types, functions, and characteristics . methods of mounting and installing . methods of aligning components Interpret: . blueprints . manufacturers' drawing and specifications	Install fans and blowers in accordance with S.M.A.C.N.A.
1002.19	install direct and indirect-fired heating equipment	State: . types and characteristics of gravity units and forced air units . advantages and disadvantages of the various types . importance of heat measurement - quantity (BTU) - intensity (temperature) . importance of factors affecting human comfort, viz., heat, humidity . importance and methods of providing adequate ventilation for boiler and furnace rooms . importance of safety codes covering installation of heating units, ducts, and vents (continued)	Install air-handling equipment in accordance with S.M.A.C.N.A.

No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
1002.19	(continued)	. methods of positioning and installing hangers . use of power-actuated stud guns . techniques of duct assembly . techniques of duct installation . importance of correct positioning and installation of fire dampers . use of sealants and taping Interpret blueprints related to directly fired and indirectly fired heating equipment	
1002.20	reassemble and install underground ductwork encased in transite and concrete	Demonstrate the following: . types of common and special materials used including plastics . methods of jointing . types and uses of joining devices . types and uses of hangers and supports . techniques of installation . types and uses of sealants and taping . methods of welding plastic . special techniques of installing collector systems . special techniques of installing flues, stacks, chimneys, and breechings Interpret blueprints for typical underground layout	Assemble and install underground ductwork in accordance with S.M.A.C.N.A.
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No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
1002.21	install duct insulation	Demonstrate the following: . types, uses, and methods of applying duct insulation - acoustic lining - thermal resistance - prevention of condensation . uses of sound baffles . types and uses of factory-built silencers . significance of decibel rating	Install duct insulation in accordance with standard trade practice and S.M.A.C.N.A.

Ministry of Skills Development
Ontario

The Honourable Gregory Sorbara, Minister

Training Module

Module Title

ARCHITECTURAL ROOFING AND SIDING

No.

U1003

Module Objective

INSTALL ROOFS, FLASHING, AND COPINGS.

Date JUNE 1985

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No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
1003.01	install roofs and copings	Identify: . styles of roofs . monitors . towers . minarets . dormers . copings . pediments . corrugated roofs . sheet metal roofs . suspended ceilings Identify roofing materials and their application: . metal . plastic . rubber . lead . canvas Identify types of joints and cleats Identify fastening methods and devices Identify waterproofing methods: . grouting . plastic sealants . solder Identify types of vapour barriers and their application State: . the importance of expansion allowances . methods of installing curbs, saddles, and roof sleeves . care and use of special roofing tools	Install roofs and copings in accordance with plans, specifications, and S.M.A.C.N.A.

No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
1003.02	fabricate and install metal siding, curbs, saddles, and roof sleeves	Make safe use of scaffolds, decks, and ladders Select and apply waterproofing and vapour barrier materials Calculate and apply expansion allowances	Fabricate and install metal siding, curbs, saddles, and roof sleeves in accordance with manufacturer's specifications and S.M.A.C.N.A.
1003.03	install flashings	Identify types of flashings: . soakers . step . cape . nip . valley . ridge . gravel stops . nosing Use proper methods of making joints and seams Use proper methods of caulking, grouting, and sealing Identify types and uses of fasteners and plugs	Install flashings in accordance with codes, specifications, and S.M.A.C.N.A.
1003.04	install skylights	Identify and properly install various types of skylights	Install skylights in accordance with specifications, codes, and S.M.A.C.N.A.

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No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
1003.05	apply weatherproofing materials	State when a vapour barrier and waterproofing materials are required	Apply weatherproofing materials in accordance with codes and S.M.A.C.N.A.
1003.06	assemble gutters and troughs	Identify types of gutters: . ogee . round . inland Describe the types and characteristics of materials used for gutters Describe the methods of: . making flat and rake mitres . installing ends and outlets . providing expansion allowances	Assemble gutters and troughs in accordance with S.M.A.C.N.A.
1003.07	assemble downspouts	Identify types, shapes, and sizes of downspouts State: . types and characteristics of materials used for downspouts . methods of assembling - conductor heads - elbows - shoes - splash pans - scuppers	Assemble downspouts in accordance with standard trade practice and S.M.A.C.N.A.

No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
1003.08	install gutters, troughs, and downspouts	Describe the care and use of scaffolds, jacks, and ladders Describe the types and uses of: . hangers - spiked and ferruled . sealants - plastic and solder	Install gutters, troughs, and downspouts in accordance with standard trade practice and S.M.A.C.N.A.
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Ontario Ministry of Skills Development

The Honourable Gregory Sorbara, Minister

Training Module

Module Title

ACOUSTIC TREATMENT (Sheet Metal Worker)

No.

U1004

Module Objective

INSTALL INSULATION MATERIALS.

Date JUNE 1985

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No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
1004.01	install internal insulation materials	Identify the types and characteristics of internal insulation materials: . acoustic lining . thermal resistance . condensation prevention Install internal insulation materials: . sound baffles . manufactured silencers	Install internal insulation in accordance with specifications, standard trade practice, and S.M.A.C.N.A.
1004.02	install external insulating materials	Identify the types and characteristics of external insulating materials and accessories: . wrap . fibre board	Install external insulating materials in accordance with the requirements of S.M.A.C.N.A.
1004.03	install microaire duct systems	Identify the types and characteristics of various types of microaire ducts: . rigid board . rigid round . flexible round	Install microaire duct systems in accordance with specifications established by S.M.A.C.N.A.

Ontario Ministry of Skills Development

The Honourable Gregory Sorbara, Minister

Training Module

Module Title

AIR BALANCING (Sheet Metal Worker)

No.

U1005

Module Objective

INSTALL AND BALANCE AN AIR HANDLING SYSTEM.

Date JUNE 1985

No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
1005.01	air balance a system	Describe and demonstrate: . pressure and the effects of its variation on equipment . balancing air flow in duct systems according to design specifications . testing high-pressure duct systems for air leaks Measure air flow in ducts State: . normal velocities in low-pressure and high-pressure systems . average velocities at grilles . average velocities through air-handling equipment . relationship between feet/minute and c/f/m/ . velocities required for conveying various materials . significance of static and velocity pressures . effects of poorly designed elbows, fan fittings, branch take-offs, and transitions Install dampers Describe: . types, uses, and methods of installing manually and automatically controlled dampers - parallel blade - opposed blade - face, face and by-pass . methods of installing blast gates and switches (continued)	Air balance a system and apply the principles of air-flow measurement and systems balancing using air-measuring instruments to determine velocities in low, medium, and high-pressure ducts in accordance with S.M.A.C.N.A. and H.R.A.I.

No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
1005.01	(continued)	. methods of installing indicating devices and control equipment Describe and demonstrate: . types of control and indicating devices . methods of installation . care and use of filter gauges and manometers Verify fan performances	
1005.02	install air-handling components	State types and demonstrate uses of: . air washers . humidifiers . dehumidifiers . spray eliminators . dust collectors . filters - their types and characteristics - electronic precipitators - activated carbon - replaceable media - washability Describe the techniques of installing collectors Describe the types and methods of installing: . preheat coils . reheat coils . direct-expansion coils for cooling and dehumidifying . electric duct heaters	Install air-handling components in accordance with standard trade practice and S.M.A.C.N.A. requirements.

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No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
1005.03	assemble and install plenums, casings, and duct work	State: . types of plenums and casings . types, weights, and gauges of materials . types of common and specialty materials such as laminated panels . types of joints and cleats . methods of joining, lapping, and fastening . methods of stiffening and reinforcing; . types and uses of fasteners . techniques of assembling and installing . importance of access doors and other openings . use of gaskets and sealants . importance of correct relationship to air-handling equipment . types and uses of handling devices such as masonry anchors, bolts, screws, rivets, nails	Assemble and install plenums, casings, and duct work in accordance with standard trade practice and S.M.A.C.N.A.

Ontario Ministry of Skills Development

The Honourable Gregory Sorbara, Minister

Training Module

Module Title

INDUSTRIAL ENVIRONMENT SYSTEMS

No.

U1006

Module Objective

INSTALL EXHAUST HOODS.

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Date JUNE 1985

No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
1006.01	assemble and install exhaust hoods	Describe and demonstrate: . types and uses of hoods - standard - canopy - fume cabinets - slotted types . types and uses of spray booths and drying booths . types and uses of machine-exhaust hoods . materials used for various types of hoods - interior and exterior . use of plastic hoods . methods of jointing and finishing seams, butt joints, and welded joints . types and uses of filters in hoods . methods of assembly . methods of installing hoods in accordance with applicable codes . methods of controlling condensation	Assemble and install exhaust hoods in accordance with requirements of S.M.A.C.N.A.
1006.02	assemble and install material-handling systems	Describe and demonstrate: . types and uses of hoods . methods of assembly . methods of joining and finishing . methods of installing dust separators	Assemble and install material-handling systems in accordance with the requirements of S.M.A.C.N.A.

Ministry of Skills Development
Ontario

The Honourable Gregory Sorbara, Minister

Training Module

Module Title

TRADE CALCULATIONS (Sheet Metal Worker)

No.

U1007

Module Objective

APPLY BASIC MATHEMATICS TO TRADE-RELATED PROBLEMS.

Date JUNE 1985

No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
1007.01	apply basic mathematical skills to trade-related problems	Define the principles and operations of the number system (whole numbers, decimals, and fractions) . powers and roots . linear measurement . square measurement . cubic measurement . angular mensuration . addition . subtraction . multiplication . division of whole numbers . weights and measures . ratio and proportion . use of tables . scale conversion . simple equations . formulae . shop calculations . right-angled and oblique triangles	Apply basic mathematic skills to trade-related problems involving: . ratio; . proportion; . direct proportion; . inverse ratio.
1007.02	convert to the metric or imperial equivalent	Define the System International [(SI) Metric]	Convert a given measurement to SI or Imperial equivalent.
1007.03	solve trade-related problems by using algebraic equations and formulae	State the formulae for the areas of the following shapes: . square, rectangle, triangle . circle, sector, segment Calculate areas of the above shapes of given dimensions	Solve trade-related problems by using algebraic equations and formulae to calculate dimensions of various shapes.

(continued)

No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
1007.03	(continued)	Define formulae for calculating the surface area of: . cubes . cylinders . cones . pyramids . combinations of the above	
1007.04	solve trade-related problems by applying geometrical theorems and functions	Define and apply the Theorem of Pythagoras	Use the Theorem of Pythagoras when required.
1007.05	calculate values	List formulae to calculate the specified values: . flow speeds . air volumes . duct sizing	Calculate values using the appropriate formulae to find: . flow speed; . air volume; . duct sizing.
1007.06	solve trade-related problems by applying trigonometrical functions	Apply trigonometrical ratios in the calculation of unknown sides and angles of a given triangle: . angles to degrees . degrees to size and ratio	Solve trade-related problems by using trigonometry.

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No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
1007.07	use trigonometry to solve trade-related problems	State the uses of and demonstrate trade applications for: . ratios . sine . cosine . tangent functions of angles of any magnitude . solution of oblique triangle . sine law . cosine law . vector composition, vector resolution . radian measure	Use trigonometry where applicable to solve trade-related problems.

Ministry of Skills Development
Ontario

The Honourable Gregory Sorbara, Minister

Training Module

Module Title

RELATED SCIENCE (Sheet Metal Worker)

No.

U1008

Module Objective

STATE CHARACTERISTICS OF AIR, WATER, SOUND, AND MACHINES.

Date JUNE 1985

No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
1008.01	state the scientific properties of metals and alloys	State the properties or concepts of: . heat and its characteristics - temperature scale - Fahrenheit/Centigrade conversion - transmission - measurement - specific heat of metals and air - heat capacity - humidity - expansion and contraction - fluxes - acids and soldering . metals and their properties - basic metallurgy - properties of materials - rates of expansion of metals - tensile, compressive, and shear strength - ferrous and non-ferrous metals - properties as related to fluxes - corrosion - special protective and anti-corrosion finishes - electrolysis - isolation of copper from other metals to prevent electrolytic action - electropotential series - anodizing - weather resistant and decorative qualities - epoxy coating on swimming pool fixtures	State the characteristics of metals and alloys and the effect of heat on them as applied to the sheet metal trade.

No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
1008.02	identify ferrous metal in sheet form	State the properties and describe the following: . iron . steel . stainless steel . coated steels - zinc - tern - lead - PVS coated (thermal setting and thermoplastics, acrylic PVCs) . carbon steels . alloy steels . aluminum and aluminum alloys - anodized - coloured - painted . copper and copper alloys . brass . bronze . lead . nickel . magnesium . tin	Identify ferrous metal in sheet form in accordance with common industrial classifications.
1008.03	describe the theory of machines 132	Describe the principles of operation of various machines Define the following terms: . mechanical advantage . efficiency . work . energy and power Calculate fan-motor horsepower requirements	Describe the theory and function of machines with reference to the sheet metal trade. 133

No.	Task To be able to:	Enabling Objectives	Terminal Performance Objective(s) Minimum acceptable standard(s)
1008.04	describe the characteristics of air, water, and sound	Describe: . air - properties - pressure and its measurement - vacuum - static pressure, and the effects of its variation (on equipment) - friction loss . water - physical and chemical properties - density - specific gravity - pressure at depth - capillarity . sound - transmission - acoustic insulation - decibel ratings	State the characteristics of air, water, and sound as applied to the sheet metal trade.
1008.05	select various types of fans	Select the proper centrifugal or axial fan, bearing in mind fan laws and the following factors: . paddle wheel fans . static and velocity pressure . total pressure . friction and dynamic loss calculations . forward inclined . backward inclined	Select the correct type of fan in accordance with installation conditions and/or specifications.